The Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Previously Presented) A lead-free joining material, produced by a process comprising:

melting tin, zinc, and at least any one of bismuth and germanium as an additive element to form a molten liquid;

forming the molten liquid into droplets; and

solidifying the droplets into particles;

wherein the particles comprise:

(a) a core part including zinc and tin as major components and at least any one of bismuth and germanium as an additive element; and

(b) a surface layer covering the core part and including the major components and the additive element, the surface layer including:

(i) a solid-solution phase in which a concentration of the additive element is higher than a concentration of the additive element in the core part, and the concentration of the additive element in the solid-solution phase is in a range of 0.6 % to 1.0 % by weight; and

(ii) a needle crystal which is more than a core part, is dispersed in the solid-solution phase and includes the zinc as a main component

wherein the concentration of the additive element in the core part is in a range of 0.3 % to 1.0 % by weight, and the surface layer has a greater concentration of the additive element than the core part,

wherein an average concentration of the additive element in the whole lead-free joining material is in a range of 0.6 % to 1.0 % by weight.

2. (Cancelled)

3. (Previously Presented) The lead-free joining material according to claim 1, wherein the surface layer has a depth of at least 2 μm from an outermost surface.

4. (Original) The lead-free joining material according to claim 1, wherein the lead-free joining material is a particle which is substantially spherical.

5. (Cancelled)

6. (Previously Presented) A lead-free solder paste, comprising:

(A) a lead-free joining material, produced by a process comprising:

(1) melting tin, zinc, and at least any one of bismuth and germanium as an additive element to form a molten liquid;

(2) forming the molten liquid into droplets; and

(3) solidifying the droplets into particles;

wherein the particles comprise:

(a) a core part including zinc and tin as major components and at least any one of bismuth and germanium as an additive element; and

(b) a surface layer covering the core part and including the major components and the additive element, the surface layer including;

(i) a solid-solution phase in which a concentration of the additive element is higher than a concentration of the additive element in the core part, and the concentration of the additive element in the solid-solution phase is in a range of 0.6 % to 1.0 % by weight; and

(ii) a needle crystal which is more than a core part, is dispersed in the solid-solution phase and includes the zinc as a main component;

wherein the concentration of the additive element in the core part is in a range of 0.3 % to 1.0 % by weight, and the surface layer has a greater concentration of the additive element than the core part,

wherein an average concentration of the additive element in the whole lead-free joining material is in a range of 0.6 % to 1.0 % by weight; and

(B) a flux.

7. (Cancelled)

8. (Previously Presented) The lead-free solder paste according to claim 6, wherein the surface layer has a depth of at least 2 μm from an outermost surface.

9. (Original) The lead-free solder paste according to claim 6, wherein the lead-free joining material is a particle which is substantially spherical.

10. (Cancelled)

11. (Previously Presented) A joining method using a lead-free joining material, comprising:

coating a solder paste to a connection, the solder paste being formed by blending the lead-free joining material and a flux, and

reflowing the solder paste,

wherein the lead-free joining material comprises a lead-free joining material, produced by a process comprising:

(1) melting tin, zinc, and at least any one of bismuth and germanium as an additive element to form a molten liquid;

(2) forming the molten liquid into droplets; and

(3) solidifying the droplets into particles;

wherein the particles comprise:

(a) a core part including zinc and tin as major components and at least any one of bismuth and germanium as an additive element; and

(b) a surface layer covering the core part and including the major components and the additive element, the surface layer including;

(i) a solid-solution phase in which a concentration of the additive element is higher than a concentration of the additive element in the core part, and the concentration of the additive element in the solid-solution phase is in a range of 0.6 % to 1.0 % by weight; and

(ii) a needle crystal which is more than a core part, is dispersed in the solid-solution phase and includes the zinc as a main component

wherein the concentration of the additive element in the core part is in a range of 0.3 % to 1.0 % by weight, and the surface layer has a greater concentration of the additive element than the core part,

wherein an average concentration of the additive element in the whole lead-free joining material is in a range of 0.6 % to 1.0 % by weight.

12. (Cancelled)

13. (Previously Presented) The joining method according to claim 11,
wherein the surface layer has a depth of at least 2 μm from an outermost surface.

14. (Original) The joining method according to claim 11,
wherein the lead-free joining material is a particle which is substantially spherical.

15. (Cancelled)

16. (Previously Presented) A joining method using a lead-free joining material, comprising:

placing the lead-free joining material on a connection pre-coated with a flux; and

reflowing the flux and the lead-free joining material,

wherein the lead-free joining material comprises a lead-free joining material, produced by a process comprising:

(1) melting tin, zinc, and at least any one of bismuth and germanium as an additive element to form a molten liquid;

(2) forming the molten liquid into droplets; and

(3) solidifying the droplets into particles;

wherein the particles comprise:

(a) a core part including zinc and tin as major components and at least any one of bismuth and germanium as an additive element; and

(b) a surface layer covering the core part and including the major components and the additive element, the surface layer including;

(i) a solid-solution phase in which a concentration of the additive element is higher than a concentration of the additive element in the

core part, and the concentration of the additive element in the solid-solution phase is in a range of 0.6 % to 1.0 % by weight; and

(ii) a needle crystal which is more than a core part, is dispersed in the solid-solution phase and includes the zinc as a main component

wherein the concentration of the additive element in the core part is in a range of 0.3 % to 1.0 % by weight, and the surface layer has a greater concentration of the additive element than the core part,

wherein an average concentration of the additive element in the whole lead-free joining material is in a range of 0.6 % to 1.0 % by weight.

17. (Cancelled)

18. (Previously Presented) The joining method according to claim 16, wherein the surface layer has a depth of at least 2 μm from an outermost surface.

19. (Original) The joining method according to claim 16, wherein the lead-free joining material is a particle which is substantially spherical.

20. (Cancelled)

21. (Cancelled)

22. (Previously Presented) A method of making a lead-free joining material, comprising:

melting tin, zinc, and at least any one of bismuth and germanium as an additive element to form a molten liquid;

forming the molten liquid into droplets; and

solidifying the droplets into particles;

wherein the particles include:

(a) a core part that includes zinc and tin as major components and at least any one of bismuth and germanium as an additive element; and

(b) a surface layer covering the core part that includes the major components and the additive element, the surface layer including;

(i) a solid-solution phase in which a concentration of the additive element is higher than a concentration of the additive element in the core part, and the concentration of the additive element in the solid-solution phase is in a range of 0.6 % to 1.0 % by weight; and

(ii) a needle crystal which is dispersed in the solid-solution phase and includes the zinc as a main component,

wherein the concentration of the additive element in the core part is in a range of 0.3 % to 1.0 % by weight, and the surface has a greater concentration of the additive element than the core part,

wherein an average concentration of the additive element in the whole lead-free joining material is in a range of 0.6 % to 1.0 % by weight.

23. (Cancelled)